

LA-UR-21-24707

Approved for public release; distribution is unlimited.

Title: Radiation Hardening – Test Capabilities (LANSCE)

Author(s): Pitcher, Eric John
Wender, Stephen Arthur

Intended for: For distribution to DoD.

Issued: 2021-05-14

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC for the National Nuclear Security Administration of U.S. Department of Energy under contract 89233218CNA000001. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Radiation Hardening – Test Capabilities (LANSCE)

Eric Pitcher, Stephen Wender

Abstract:

The Los Alamos Neutron Science Center (LANSCE) has exceptional facilities for research and testing of radiation effects in electronics. We have the best terrestrial neutron source for sea-level and airplane-altitude environments. We have a thermal neutron test capability at the Lujan Center and a proton beam test capability at the “Blue Room”. LANL has the programmatic mission to develop this radiation-effects program, namely space and satellite environments, high-performance computing (silent data corruption), and weapons delivery systems. We have a strong connection to industry which continues to grow.



Radiation Hardening – Test Capabilities (LANSCE)

Eric Pitcher for Stephen Wender

12 May 2021

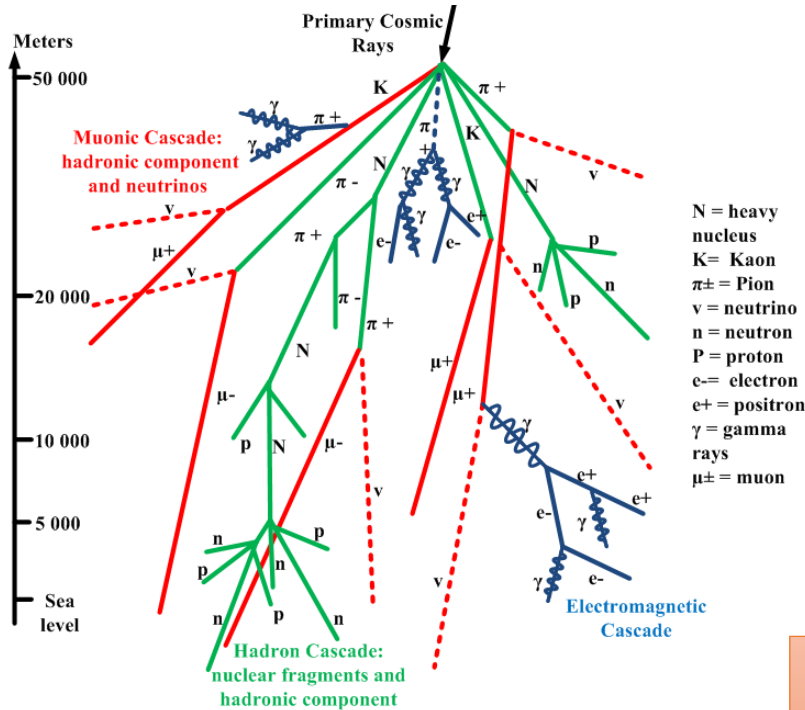
LANSCe has exceptional facilities for research and testing of radiation effects in electronics

- We have the best terrestrial neutron source for sea-level and airplane-altitude environments
- Thermal neutron testing at the Lujan Center
- Proton beam testing at the “Blue Room”
- We have the programmatic mission to develop this radiation-effects program
 - Space and satellite environments
 - High-performance computing (silent data corruption)
 - Weapons delivery systems
- We have a strong connection to industry which continues to grow

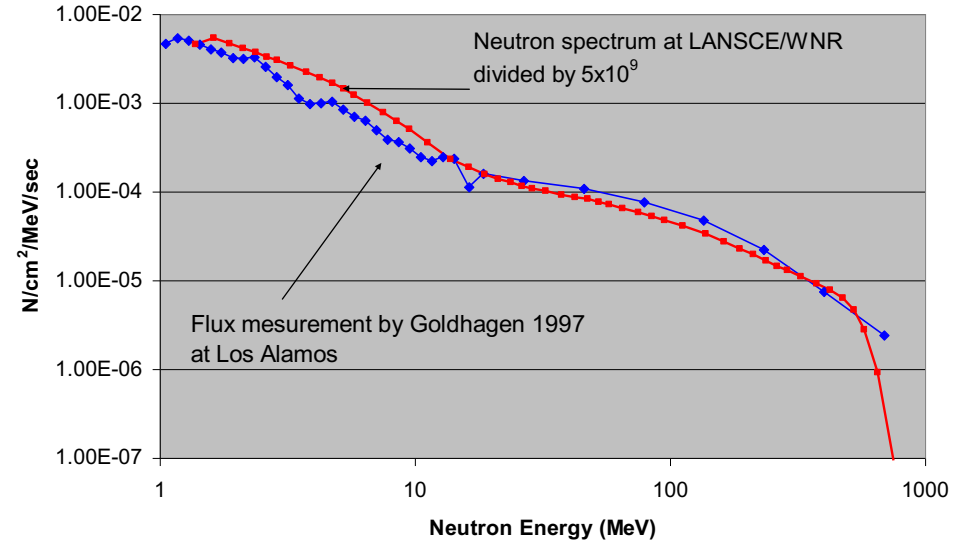


Los Alamos Neutron Science Center
(LANSCe)

The LANSCE neutron spectrum matches that produced in the atmosphere by cosmic rays



Neutron Flux at Los Alamos and LANSCE/WNR



LANSCE neutron flux is $\sim 10^6$ more intense than the atmospheric flux at airplane altitudes.

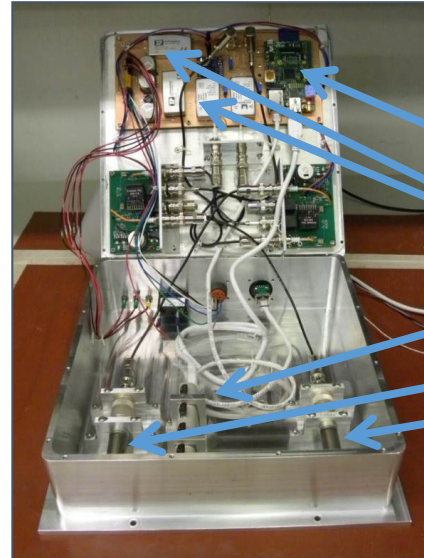
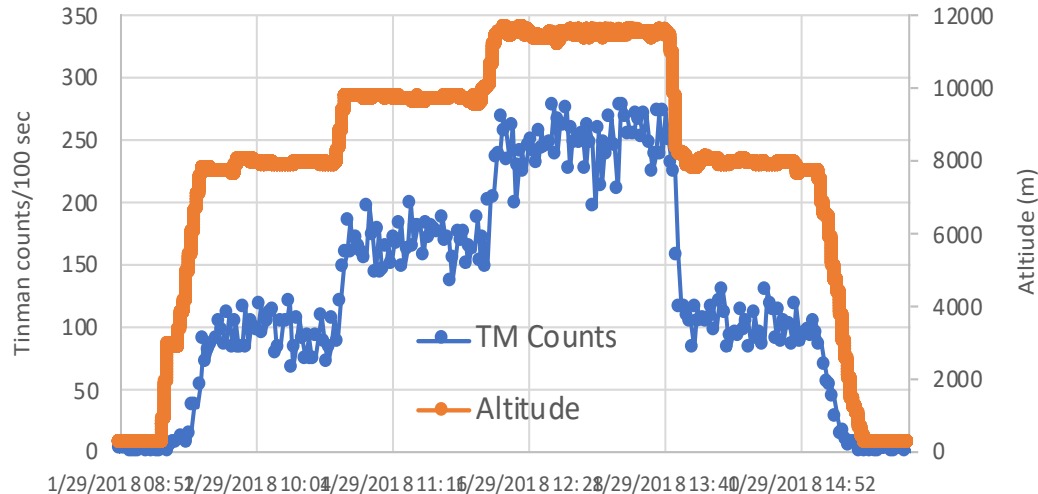
LANSCCE serves as an industry standard for qualifying semiconductors



The JEDEC Solid State Technology Association Engineering Standard JESD89A explicitly recognizes the LANSCCE "Ice House" facility for accelerated testing.

With Honeywell, Inc., we developed the “Tinman” to measure the thermal neutron flux in aircraft

- Final detector was fabricated by ISR Division at LANL to space specifications
- NASA DC-8 flight showed linear relationship between altitude and $\log(\text{thermal flux})$



Raspberry Pi

DC-to-DC converter
power supplies

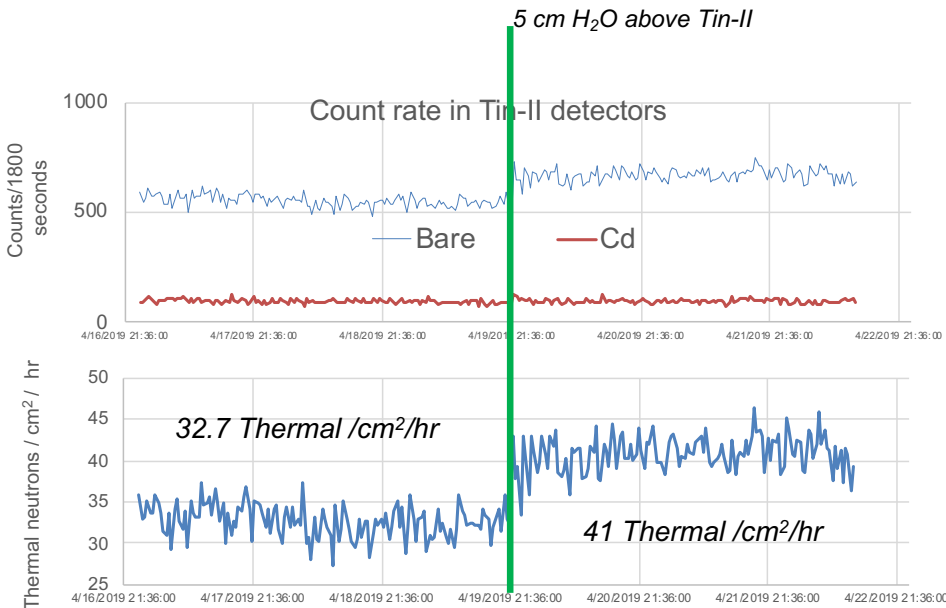
Shaping pre-amps

Cylindrical ^3He ion
chambers

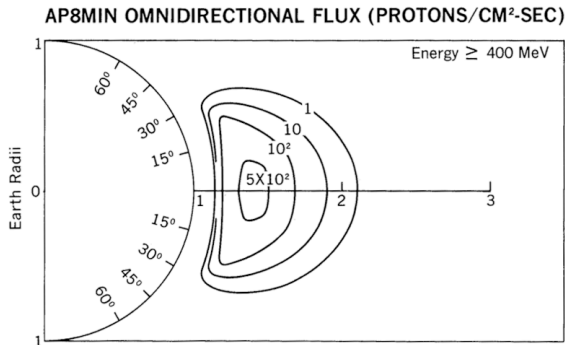
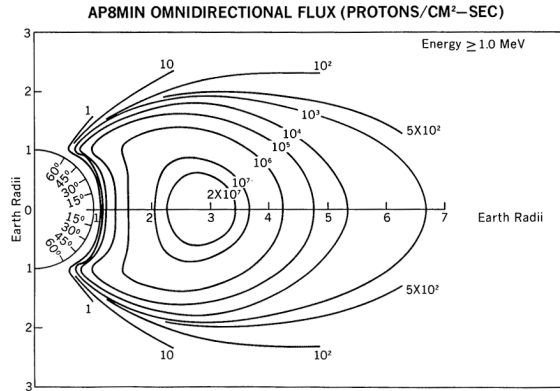
Detectors are monitoring the radiation environment at LANL's High-Performance Computing area



- High-energy cosmic-ray showers will produce an increase in thermal neutron flux
- Increase in thermal flux observed with Tinman detector



A dedicated proton test capability could be stood up at LANSCE



- Protons are the greatest threat to electronics in space
 - Due to the high cost of space-based systems and the importance of their missions, it is crucial to test and qualify electronic components before they are launched into space
 - It is presently not possible to predict the failure rate from models
 - In the past, many parts were qualified using the Indiana University Cyclotron Facility (IUCF) at 200 MeV
 - With the 2014 closure of IUCF, there has been an ongoing need for a dedicated proton testing facility
- Experiments currently conducted in our “Blue Room”
- We are exploring options for a low-power test facility

LANSCE can expand its testing capability to serve the electronics community for radiation effects testing

- We have a well-established program for high-energy neutron effects testing
 - More than a dozen industry users each year (~50% use)
 - Space (ISR Division) and HPC users from LANL (~30%)
 - University and other national labs (~20%)
- We have a proposal to construct a thermal neutron flight path dedicated to radiation effects testing at the Lujan Center
 - Multiple requests from industry for such a test capability at LANL
 - ISR and HPC have performed experiments on existing beamlines
- We are exploring options to provide a dedicated proton beam test facility